

We claim:

1. A composite material, comprising:

a ceramic matrix; and

Sub A12  
two different fractions of fiber bundles including a reinforcing fiber bundle fraction and a matrix fiber bundle fraction having different average fiber bundle lengths, said fractions of fiber bundles separated by a minimum in a total fiber bundle distribution being a function of a fiber bundle length.

Sub D2  
2. The composite material according to claim 1, wherein at least a portion of said fiber bundles at least partly have at least one protective layer.

Sub B2  
3. The composite material according to claim 1, wherein said fiber bundles contain fibers selected from the group consisting of carbon fibers, graphite fibers, SiC-fibers, aluminum oxide fibers,  $\text{Al}_2\text{O}_3\text{SiO}_2$ -fibers,  $\text{Al}_2\text{O}_3\text{SiO}_2\text{B}_2\text{O}_3$ -fibers, carbonized types of cellulose fibers, wood fibers, other organic fibers and fibers highly resistant to elevated temperatures based on compounds containing Si, C, B, N, Al.

4. The composite material according to claim 1, wherein said fiber bundles contain at least one of nano fibers, whiskers and nanotubes at least partly in place of fibers.

5. The composite material according to claim 1, wherein said ceramic matrix contains phases of at least one substance selected from the group consisting of carbon, silicon, boron, aluminum, zirconium and alloys selected from the group consisting of silicon carbide, silicon nitride, silicon oxide, boron nitride, boron carbide, SiBCN,  $Al_2O_3$ ,  $ZrO_2$ , TiC, iron silicides, other silicides and glass-ceramics.

6. The composite material according to claim 5, wherein said ceramic matrix contains additions selected from the group consisting of iron, chromium, titanium, molybdenum, nickel and aluminum.

7. The composite material according to claim 5, wherein said fiber bundles are carbon and graphite fiber bundles.

8. The composite material according to claim 7, wherein said ceramic matrix contains phases of at least one of silicon, carbon and silicon carbide.

9. The composite material according to claim 1, including a fraction of overlong fiber bundles, in addition to said reinforcing fiber bundle fraction and said matrix fiber bundle fraction.

10. The composite material according to claim 1, wherein at least one of said reinforcing fiber bundle fraction and said matrix fiber bundle fraction are composed of several fiber bundle fractions with different average fiber bundle lengths.

11. The composite material according to claim 1, wherein said average fiber bundle length of said reinforcing fiber bundle fraction is between 4 mm and 20 mm.

12. The composite material according to claim 1, wherein said average fiber bundle length of said matrix fiber bundle fraction is between 0.2 mm and 5 mm.

13. The composite material according to claim 1, wherein said reinforcing fiber bundle fraction has an average fiber bundle width between 0.02 mm and 5 mm.

14. The composite material according to claim 1, wherein said matrix fiber bundle fraction has an average fiber bundle width between 0.02 mm and 2 mm.

15. The composite material according to claim 1, wherein a ratio of said average fiber bundle length of said reinforcing fiber bundle fraction to said average fiber bundle length of said matrix fiber bundle fraction is between 1.5 and 10.

16. The composite material according to claim 1, wherein a ratio of said average fiber bundle length of said reinforcing fiber bundle fraction to an average fiber bundle width of said reinforcing fiber bundle fraction is between 2 and 500.

17. The composite material according to claim 1, wherein a ratio of said average fiber bundle length of said matrix fiber bundle fraction to an average fiber bundle width of said matrix fiber bundle fraction is between 2 and 500.

18. The composite material according to claim 1, wherein said reinforcing fiber bundle fraction has an average length/width/height ratio of between 2 and 50,000.

19. The composite material according to claim 1, wherein said matrix fiber bundle fraction has an average length/width/height ratio of between 2 and 50,000.

*20*  
20. The composite material according to claim 1, wherein a ratio of a weight of said matrix fiber bundle fraction to a weight of all fiber bundles is between 0.1 and 0.8.

21. The composite material according to claim 1, wherein said reinforcing fiber bundle fraction has a width at half maximum of a fiber bundle length distribution of between 0.01 mm and 15 mm.

22. The composite material according to claim 1, wherein said matrix fiber bundle fraction has a width at half maximum of a fiber bundle length distribution of between 0.01 mm and 5 mm.

23. In a method for manufacturing composite materials reinforced with fiber bundles and having a ceramic matrix, the improvement which comprises:

*Sub A13*  
providing two different fractions of the fiber bundles including a reinforcing fiber bundle fraction and a matrix

fiber bundle fraction with different average fiber bundle lengths, as basic materials; and

Sub A13  
Cont  
providing a total fiber bundle distribution as a function of a length of the fiber bundles with a minimum between the average fiber bundle lengths of the reinforcing fiber bundle fraction and the matrix fiber bundle fraction.

24. The method for manufacturing composite materials according to claim 23, which further comprises initially mixing the two different fractions of fiber bundles, subsequently pressing the mixed fractions of fiber bundles into a molded body, and then infiltrating the molded body with polymers.

25. The method for manufacturing composite materials according to claim 24, which further comprises infiltrating further fillers in addition to the polymers.

26. The method for manufacturing composite materials according to claim 23, which further comprises adding the two different fractions of fiber bundles to other components during a mixing process to form a mixture.

27. The method for manufacturing composite materials according to claim 23, which further comprises providing at least a portion of the fiber bundles at least in part with at least one protective layer.

28. The method for manufacturing composite materials according to claim 23, which further comprises using only carbon and graphite fiber bundles.

29. The method for manufacturing composite materials according to claim 26, which further comprises using only carbon and graphite fiber bundles.

30. The method for manufacturing composite materials according to claim 26, which further comprises mixing the two different fractions of fiber bundles with at least one carbonizable binder during the mixing process.

31. The method for manufacturing composite materials according to claim 28, which further comprises mixing the two different fractions of fiber bundles with at least one carbonizable binder during the mixing process.

32. The method for manufacturing composite materials according to claim 31, which further comprises selecting a binder from the group consisting of resins and pitches as the at least one carbonizable binder.

33. The method for manufacturing composite materials according to claim 32, which further comprises compressing the mixture after the mixing step.

34. The method for manufacturing composite materials according to claim 33, which further comprises carrying out the compressing step at an elevated temperature.

35. The method for manufacturing composite materials according to claim 33, which further comprises subjecting the molded body after the compressing step to a temper process above a curing temperature of resin binders in the mixture.

36. The method for manufacturing composite materials according to claim 34, which further comprises carbonizing the at least one carbonizable binder in a further process step.

37. The method for manufacturing composite materials according to claim 36, which further comprises carrying out



graphitization at temperatures above 2000 °C as a further process step.

38. The method for manufacturing composite materials according to claim 36, which further comprises carrying out siliconizing in a final process step.

39. The method for manufacturing composite materials according to claim 37, which further comprises carrying out siliconizing in a final process step.

40. The method for manufacturing composite materials according to claim 23, which further comprises setting the average fiber bundle length of the reinforcing fiber bundle fraction to between 4 mm and 20 mm.

41. The method for manufacturing composite materials according to claim 23, which further comprises setting the average fiber bundle length of the matrix fiber bundle fraction to between 0.2 mm and 5 mm.

42. The method for manufacturing composite materials according to claim 23, which further comprises setting a ratio of the average fiber bundle length of the reinforcing fiber

bundle fraction to the average fiber bundle length of the matrix fiber bundle fraction to between 1.5 and 10.

43. The method for manufacturing composite materials according to claim 23, which further comprises setting an average length/width/height ratio of the reinforcing fiber bundle fraction to between 2 and 50,000.

44. The method for manufacturing composite materials according to claim 23, which further comprises setting an average length/width/height ratio of the matrix fiber bundle fraction to between 2 and 50,000.

45. The method for manufacturing composite materials according to claim 23, which further comprises mixing the two fractions of fiber bundles to form a mixture, and setting a combined weight fraction of the fiber bundles of the two fiber bundle fractions used in the mixing step to 50 to 99 % of a total weight of the mixture.

46. The method for manufacturing composite materials according to claim 23, which further comprises mixing the two fractions of fiber bundles to form a mixture, and setting a weight fraction of the fiber bundles of the reinforcing fiber

bundle fraction used in the mixing step to 20 to 80 % of a total weight of the mixture.

47. The method for manufacturing composite materials according to claim 23, which further comprises mixing the two fractions of fiber bundles to form a mixture, and setting a weight fraction of the fiber bundles of the matrix fiber bundle fraction used in the mixing step to 10 to 40 % of a total weight of the mixture.

48. The method for manufacturing composite materials according to claim 23, which further comprises setting a ratio of a weight of the matrix fiber bundle fraction to a weight of all of the fiber bundles at between 0.1 and 0.8.

49. A method for manufacturing gas turbine parts, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

50. A method for manufacturing parts of burners, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

51. A method for manufacturing nozzles and nozzle parts, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

52. A method for manufacturing hot-gas pipes, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

53. A method for manufacturing measuring probes, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

54. A method for manufacturing jacket tubes for probes, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

55. A method for manufacturing brake-discs for aircraft, rail vehicles and motor vehicles, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

56. A method for manufacturing brake-discs for aircraft, rail vehicles and motor vehicles, which comprises providing a

composite material reinforced with fiber bundles and having a ceramic matrix according to claim 8.

57. A method for manufacturing brake-linings for aircraft, rail vehicles and motor vehicles, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

58. A method for manufacturing brake-linings for aircraft, rail vehicles and motor vehicles, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 8.

59. A method for manufacturing thermal shields, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

60. A method for manufacturing thermal protective components of spacecraft and aircraft engines, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

61. A method for manufacturing components of sliding bearings and sliding elements, which comprises providing a composite

material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

*Fig 4*  
62. A method for manufacturing components of sliding bearings and sliding elements, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 8.

63. A method for manufacturing carrier components for mirrors, antennas and reflectors, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

64. A method for manufacturing missile components, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

65. A method for manufacturing fire grates, which comprises providing a composite material reinforced with fiber bundles and having a ceramic matrix according to claim 1.

66. A method for manufacturing components of heat exchangers, which comprises providing a composite material reinforced with

9/1/02 fiber bundles and having a ceramic matrix according to claim

1.

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